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PATENT NO. 235,494 B1

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FIBROUS LAYER, METHOD FOR ITS PRODUCTION AND EQUIPMENT FOR
IMPLEMENTING THE METHOD FOR THE PRODUCTION OF THE FIBROUS LAYER

Inventors:	Jaroslav Hanus and Dalibor Rychlik, Liberec
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A fibrous layer (8) is made of compressed folds (22) in the form of waves that run the entire width of the fibrous layer (8) and are cut close to each other in the longitudinal direction. The height of the wavelines (22) determines the final thickness of the fibrous layer (8). The compressed folds (22) of the fibers are connected to each other in the longitudinal direction. The

invention for the production of fibrous layer (8) consists of the textile material (7) being removed from part of the circumference of the pinned drum (1), where this part of the circumference corresponds to one oscillation of the take-off element (2). The removed textile material (7) is overlapped approximately half the length of the cited part of the circumference and the resulting fold of fibers is pressed up against the previous similarly formed fold (22). The equipment is characterized in that a board (4) and a body (3) are disposed relative to the pinned drum (1) of the carding machine in such a way that they form a slot (21) into which the take-off bar (18) of the take-off element (2) intrude. The fibrous layer (8) is removed by a bottom (6) and a top conveyer belt (5). The invention includes further embodiments of the fibrous layer (8) and the equipment.

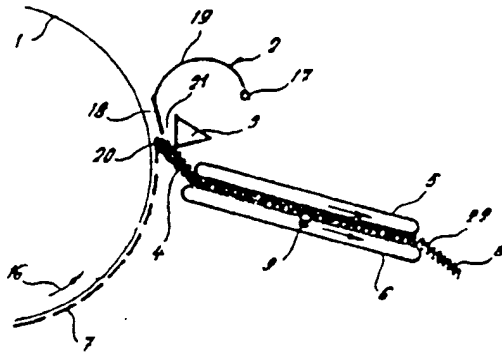


Figure 5

The invention relates to fibrous layers created by the formation of fibers taken off by an oscillating take-off element from the surface of the pinned drum of the machine in such a way that for a length of the circumference equal to the portion of the drum that corresponds to one oscillation of the take-off element, the fibers are overlapped and pressed up against the previous fold, which was made in the same way, with the individual folds being connected by fibers punched from the last-formed fold into the previous folds, so that connection is made at any given place between the planes defining the thickness of the layer and at a preselected spacing along the width of the layer. The individual folds of the fibers may also be joined to each other by heat, pressure and moisture or by reinforcing threads. In an alternative embodiment, the compressed folds of the fibers may be also be tacked to a flat textile base.

The fibrous layer is created from fibers formed into regular wavelines with an amplitude of 8 to 10 mm, the wavelength is twice the diameter of the fiber, up to 5 mm; the waves are joined together by fibers, for example in the axis of the wavelines and spaced 3 to 100 mm apart across the width of the layer.

The equipment for making this layer consists of elements creating a stuffing slot and further of a vibrating take-off element provided with needles with external cuts, with the take-off element being disposed toward the pinned drum and the elements creating the stuffing slot.

Currently known methods for producing fibrous layers involve layering fibrous layer taken off the pinned drum. To implement these methods, vertical or horizontal web-formers are used. Layers formed in this way are readily abraded even after being reinforced, for example by saturation, the fibers lie

predominantly in the plane of the layer and do not pass from one face of the layer to the other. Another method is based on using what is called the Wirr effect, where the fibers on the pinned drum are compacted and randomly distributed mechanically in such a way that the arrangement of the fibers in the layer forms an more isotropic structure than in the previous state. These layers can then be further processed on mechanical web-formers. Even then the fibers do not pass from one face of the layer to the other.

A further method for creating a fibrous layer uses the fibers removed from the pinned drum as a base for the pneumatic formation of the web, where the fibers are blown or sucked onto a mesh drum. In this case, fibers do pass from one face of the layer to the other, but the layer contains a whole series of randomly deformed fibers that later prevent the properties of these fibers forming the layer from being fully utilized.

Equipment for manufacturing fibrous layers by the methods referred to either occupies large areas, whether horizontal or vertical web-formers are used, or is energy intensive, as in the case of pneumatic equipment. In general, these methods are not suitable for certain purposes. This is because the flexibility of the fibers is not taken advantage of, and during stripping from the drum, entire fibers are lost, not just their ends, and a smaller number of fibers is used for conducting moisture from one face of the layer to the other and the paths for transporting moisture through the layer are made more complicated.

The manufacture of looped bonded carpeting is claimed in Czechoslovak Patent No. 56029. The patent describes a fibrous web being alternately folded by a special device consisting essentially of two parallel wires moving with an alternating

reciprocal motion. In addition to their motion in the same plane, the wires also move in a perpendicular direction in such a way that they alternately overlap and clear each other, and in this way they form the folded band of web into the shape of an accordion. In a later operation, a bonding agent is applied to the surface of the band of folded web and the web is glued to the base fabric, which may also have a bonding agent applied to it. The fabric may also be glued on both sides of a layer of the folded web, and the double plush can be cut into two-pile carpeting. When the fabric is glued on only one side, a kind of loop bonded carpet is obtained.

Web can also be folded with the aid of cams on a pair of rollers according to Czechoslovak Patent No. 62475. Its motion is coordinated with auxiliary oscillating equipment with the delivery or insertion of separating wires that simultaneously place the web in the descending chute as they fold it and are pushed forward together with the web. Application of the bonding agent and further operations are as described in the preceding example.

The principle of folding the web also forms the basis for a method of manufacturing bonded pile carpets described in Czechoslovak Patent No. 87556. Unlike in the other methods, the continuous belt of web, or roving or yarn, as the case may be, is alternately folded by the oscillating knives and simultaneously pressed directly into the activated layer of bonding agent on the backing fabrics which are brought up against both faces of the web. Folding and simultaneous pressing of the web directly into the bonding agent requires that the bonding agent penetrate the entire thickness of the web while being cut by the knife and that a bond be formed with the backing. A rubber vulcanizing mixture

diluted on the machine just before the loading device has proved fairly successful.

The mixture must contain the required vulcanizing additives to allow a permanent bond to form. The carpeting is cut halfway through the folds by a band knife. The bonding agent is vulcanized before the cutting step. The final article is similar in appearance to products manufactured by other processes. Jute is used as the backing material. The bonding agent is applied to its surface by spreading high-viscosity solutions of rubber or by applying the rubber mixtures on a multiroller calender. The web that is being bent and compressed in the oscillating equipment has its fibers oriented as well as possible in the longitudinal direction to produce a vertical plush in the product.

The methods of carpet manufacture described require the use of two fabrics, between which the web is placed.

The principle of creating loops from web and gluing them to a backing material is used in several manufacturing methods.

Loops of web, cord, roving or yarn are formed, for example, by means of jaws and a heated applicator blade that presses the formed loop into the backing with the applied thermoplastic bonding agent. This principle is used in U.S. Patent No. 2638960.

The formation of loops or crimping the web can also be accomplished by the method cited in West German Patent No. 1002724. Teeth are made in the circumference of a large drum between which the web is compressed by the delivery mechanism. The folded fibrous belt is coated with a rubber mixture along the top and paired with a backing material to which bonding agent has also been applied. The loop bonded textile, for example carpeting, is dried and vulcanized. In this method, the crimped web is made by teeth, which themselves have a certain thickness.

When the teeth are removed, the loops that were formed come apart to some extent, since they were not compressed tightly together when they were glued to the backing.

The above disadvantages are eliminated by a layer according to the invention in which the fibers are arranged in wavelines with the result that the transport pathway for conducting moisture from one face to the other is short and that the entire fiber is not removed when abraded because the abrasion affects only the crests of the bent fibers, and the layer is flexible. A layer with such a structure has better physiological properties, e.g., a higher sorption rate and higher permeability to air. Such a layer can be formed by creating a stuffing slot near the pinned drum in which the fibers taken off the pinned drum are placed in a length corresponding to one oscillation of the comb in such a way that it is folded approximately in half and pressed up against the preceding fold, with the individual folds being connected to each other either by fibers from the last-made fold through preceding folds at any point between the planes defining the thickness of the layer and in a preselected spacing across the width of the layer, or they may be connected by heat, pressure and moisture. The resulting layer is removed from the slot, for example between conveyer belts passing through the zone of mechanical action which evens out any stresses that may have developed in the layer. A layer produced by this method can then be treated by any known method used in the manufacture of nonwoven textiles.

The fibrous layer of staple fibers according to the invention consists essentially in that these fibers form compressed folds in the form of wavelines that extend across the entire width of the fibrous layer and are compressed one after

another in the longitudinal direction of the fibrous layer. The height of the wavelines determines the thickness of the entire fibrous layer. A fibrous layer made in this way can be reinforced in the longitudinal direction, meaning that the compressed folds of fibers are bound together at selected locations between the planes determining the thickness of the fibrous layer and at selected spacings across the width of the fibrous layer. This connection between the compressed folds is produced either by using their own fibers or by reinforcing threads. The compressed folds of fibers can also be attached to a textile fabric.

In addition to the usual web fibers, the fibrous layer also contains short thick fibers constituting up to 25 wt% of the entire weight of the product. The staple of these fibers is about 3 to 7 mm. These short fibers ensure the cohesion of the individual folds of the fibrous layer and form its binding points.

In manufacturing fibrous layer, the staple fibers are removed from the surface of the rotating pinned drum by a vibrating take-off element. The method of the invention consists of the fibers being removed from a portion of the circumference of the pinned drum by a take-off element and overlapped. The resulting fold is pressed up against the preceding, similarly formed compressed folds, which hold together and are taken off the machine. The portion of the pinned drum from which the fold of fiber is made is proportional to the time of one vibration of the take-off element.

The equipment for implementing this production method is characterized in that a board is disposed relative to the pinned drum and to the bottom edge of the take-off element at the location of the lowest position of the bottom edge of the

take-off element, and a body is disposed relative to the same bottom edge at the location of the highest position of the bottom edge of the take-off element in such a way that the board and the body form a slot running the entire width of the pinned drum. The folds of the fibers pass through the slot so formed. In working position, the bottom edge of the take-off element is oriented toward the slot. The position of the body is adjustable relative to the board and is so shaped that it forms a single minimum slot width with the board. The edge of the body forming the minimum slot width may be flexible.

Alternatively, the body may be enclosed by a planchet, one end of which is connected to the shaft of the take-off element and the other end of which is seated against the board, or the body may be made in the form of a roller extending across the entire width of the machine, parallel to the board, with this roller rotating with a circumferential speed corresponding to the speed of the layer leaving the slot, or the body may be made as the input part of the upper offtake conveyer belt. The surface of the roller or conveyer belt must be roughened, for example by grooving or by applying a suitable coating, for example emery, for the purpose of delivering the layer up to the slot and carrying it away. To simplify the equipment, the board can be replaced by using the bottom conveyer belt directly, with the belt being led through the smallest possible radius of the drum. This solution is only a substitute, however.

The bar of the take-off element of the invention is provided with needles with external cuts at selected spacings. The needles are bent into an arc having the same radius as the radius of vibration of the bottom edge of the take-off bar.

The production method of the invention can be implemented in an area approximately one-fifth that required for horizontal web-formers and consumes approximately one-tenth the energy used in manufacturing fibrous layer on pneumatic equipment. A further advantage is that it enables installation of a stuffing slot directly on the take-off drum of the carding machine or garnett machine and the use of an ordinary comb as the take-off element.

The resulting structure advantageously affects the abrasion resistance of nonwoven textiles made from this layer, as well as its flexibility, which is useful in carpet backing, as well as the rate of sorption of liquids and permeability to air. It can also be considered an advantage that the method of the invention can form fibrous layer from virtually all types of fiber, fiber blends, including types containing very short fibers or mixtures of long and very short fibers, and even mixtures that contain fairly crude contaminants. This is because the length of the path between the compression step and the drum on which the material is spread is practically zero, while when horizontal pilers are used there are many more and larger places where the fibrous layer can be damaged. This fact also comes into play, for example, when working with secondary fiber sources of very low quality. To increase strength, the layer can be laminated with another textile; a foil mesh can advantageously be used, if it can be reinforced with continuous fibers.

A concrete embodiment of the invention is illustrated schematically in the attached drawings, where Figure 1 shows a three-dimensional view of the fibrous layer leaving the slot in the machine before entering the space between the conveyer belts; Figure 2 shows the same layer as in Figure 1, but its individual folds are connected by its own fibers punched through them;

Figures 2a and 2b is the layer shown in Figure 2 in cross section and longitudinal section; Figure 3 is a view of a layer reinforced by threads; Figure 4 is a view of a layer reinforced by textile; Figure 5 is one embodiment of the equipment with a solid body; Figure 6 is the equipment provided with a flexible planchet around the body; Figure 7 is a modification of the equipment for producing fibrous layer reinforced by threads; Figure 8 is an embodiment of the equipment for producing fibrous layer reinforced by textile; Figures 9 and 10 show the arrangement of the take-off element for joining individual folds of the layer by punching the fibers of the layer into the preceding folds of fiber; Figure 11 shows an embodiment of the body; Figure 12 shows a possible embodiment of the body; and Figure 13 shows a possible embodiment of the board.

Figure 1 illustrates a fibrous layer (8) produced according to the invention showing the thickness twice the amplitude A of the wavelength d . The fibrous layer (8) is made up of compressed folds (22) of fiber.

Figures 2, 2a and 2b show the same fibrous layer (8) that is reinforced at selected spacings t with its own punched fibers (14), which pass from the last-formed compressed fold (22) during production into the previously formed folds (22). The arrow (10) indicates the longitudinal direction of the fibrous layer (8). The actual fibers (14) are, as shown in Figure 2b, punched in the plane o of fibrous layer (8), with this plane o lying, in this instance, within the thickness of the compressed folds (22) of the fibers.

Layers such as this can be produced on equipment such as that shown in Figure 5, where a board (4) is disposed toward the pinned drum (1) at the location of the lower position of the

bottom edge (20) of the take-off element (2) and body (3) is disposed at the location of the upper position of the bottom edge (20) of the take-off element (2) in such a way that the board (4) and the body (3) create a slot (21) along the entire width of the pinned drum (1). Two conveyer belts are then disposed toward the exit from the slot (21), a bottom conveyer belt (6) and a top conveyer belt (5). The take-off element (2) is provided with a take-off bar (18) which carries needles (13) at spacing t having external cuts (15).

Take-off bar (18) is connected to a shaft (17) by means of planchets (19). The pinned drum (1) rotates in the direction shown by arrow (16). The bottom conveyer belt (6) is provided in one location across its entire width, shown in Figure 5 as being approximately in the center of the length of the conveyer belt (6) with a cam (9), which rotates and oscillates the upper branch of the bottom conveyer belt (6) and fibrous layer (8), together with the lower branch of the top conveyer belt (5). This motion, transmitted to the fibrous layer (8) equalizes the stresses within this layer.

The equipment operates in the following manner: fibrous material (7), caught on the needles of the pinned drum (1), proceeds under board (4) to the take-off element (2), which removes a length of it from the surface of the drum (1) corresponding to the length of one oscillation of the take-off element (2), bends it past the upper edge of the board (4), places it between this length and pushes it to the slot (21) between the board (4) and the body (3). The slot (21) between the board (4) and the body (3) at its place of minimum profile and speed of the conveyer belts (5) and (6) virtually controls the weight of the resulting fibrous layer formed (8), which is

removed on the bottom conveyer belt (6) or between the two conveyer belts (5) and (6). The equipment shown in Figure 5 produces the fibrous layer (8) illustrated in Figure 1. When the take-off bar (18) is provided with needles (13), fibrous layer (8) as shown in Figure 2 results. Every fold (22) of fibers is connected to the preceding folds (22) by means of its own fibers. The needles (13) are made, for example, as punch needles and penetrate the fibrous layer (8) of the fiber. They punch every new fold (22) of fibers to the preceding folds (22), producing the structure shown in Figure 2.

The embodiment of the equipment shown in Figure 6 differs only in the arrangement of board (4) and body (3), where the body (3) is surrounded by a flexible planchet (31) in such a way that one edge of the planchet (31) is clamped to shaft (17) of take-off element (2). This arrangement results in the simultaneous oscillation of take-off element (2) and planchet (31), facilitating the passage of the fibrous layer (8) through the slot (21). This arrangement is suited to lighter weight fibrous layers (8).

Figure 3 shows fibrous layer (8), which is reinforced by threads (11). The equipment used to produce it is illustrated in Figure 7. Reinforcing threads (11) are conducted over the surface of the pinned drum (1) below the layer of textile material (7), entering the slot (21) on the upper edge of board (4) above the layer of textile material (7). The individual compressed folds (22) of fibers are slid onto these tightened reinforcing threads (11). The take-off bar (18) may also be provided with needles (13) as shown in Figures 9 and 10.

Figure 8 illustrates the arrangement of equipment for producing a fibrous layer (8) as shown in Figure 4, which is

reinforced by a flat structure (12), for example by a nonwoven textile, to which folds (22) of fiber are tacked. Take-off bar (18) is, in this case, provided with needles (13) as shown in Figures 9 and 10. Fibrous layer (8) is attached to flat structure (12) by its own fibers. The flat structure (12) is carried toward the upper edge of board (4) and to the slot (21) below the textile material (7), or below the folds (22) of fibers.

The bond between the individual compressed folds (22) of fibers can be maintained until the subsequent operation or until later processing of the fibrous layer by suitable selection of the raw material for making the layer. This can be accomplished, for example, by using wool fibers or by adding to the web fibers short fibers 3 to 7 mm long in quantities up to 25 wt% of the total fibrous layer. The short fibers create binding points for the individual folds. Good bonding of the folds can also be achieved by damping the layer in the stuffing slot (21), for example by applying moisture by means of the two conveyer belts (5) and (6). Water can be used or a glue, preferably in the form of an aqueous dispersion.

Figure 11 illustrates an embodiment of body (3) and its lower flexible edge (23), made for example of rubber. Alternatively, this lower edge (23) may be made of Silon pile in the form of a brush. The purpose of this embodiment of the body (3) is to catch and clamp the initial folds (22) at the beginning of the process of producing the fibrous layer (8) until the stuffing box (21) is filled with fibrous material (7). This prevents the loss at the beginning of the process of material before the width of slot (21) is filled with fibrous layer (8). The flexible lower edge (23) of body (3) also enables the production of lightweight fibrous layer (8).

Figure 12 illustrates an embodiment in which body (3) is replaced by the input part of the top conveyer belt (5). This simplifies the embodiment of the equipment without loss of functionality in producing fibrous layers (8) of heavier weights.

According to Figure 13, board (4) is replaced directly by bottom conveyer belt (6), and body (3) is also here created by top conveyer belt (5). This embodiment reduces the number of component elements of the equipment.

Example 1

Fibrous layer made from torn-up apparel waste and additionally reinforced by passing continuous fibers through it, for example on an Arachne machine. The product is suitable for use as a packing material.

Production process:

The raw material is loaded for processing on a roller carding machine, with its take-off and combing elements being disposed so as to form a slot. The combing component is provided with needle punches according to the invention, in this case with a needle spacing equal to 3 mm. The offtake speed was 18 m/min, the comb vibrated at a rate of 1700 rpm, the discharge speed of the layer from the slot was 1.3 m/min, the thickness of the layer was 6 mm, its weight was 200 g/m², the individual folds of web are bound together by their own fibers at a spacing $t = 3$ mm. This layer is conveyed to a braiding machine, for example, an Arachne machine.

Example 2

A fibrous layer made of 100% PES additionally reinforced by impregnation with an acrylate dispersion. The product is suitable for use as an air or water filter.

Production process:

The raw material, 100% PES, 3.1 dtex/57 mm, is loaded for processing on a roller carding machine, close to which offtake and combing element, which is provided with punch needles, are disposed elements forming the slot of the invention. At an offtake speed of 18 m/min, comb speed of 1700 rpm, discharge speed of 1 m/min, a fibrous layer is produced that has a weight of 200 g/m², a thickness of 6 mm, which is impregnated with acrylate dispersion. After expression and drying, a layer with a weight of 260 g/m² and a thickness of 3.5 mm is obtained.

Example 3

A fibrous layer from torn waste in which the individual folds are connected by yarn. The product is suitable for a thermal insulating layer.

Production process:

The raw material is loaded on a carding machine with a 300 mm diameter doffer, close to whose are disposed elements creating a stuffing slot and a combing element. The combing element is again provided with punch needles. At an offtake speed of 18

m/min, comb speed of 1700 rpm, discharge speed of 0.6 m/min, a fibrous layer is produced that has a weight of 450 g/m^2 , a thickness of 8 mm. Reinforcing yarn is brought up to the slot above the layer of fibers and the finished product lies inside the layer.

Example 4

A fibrous layer made of 100% synthetic secondary fiber raw material, with every fold punched into a nonwoven textile of synthetic fiber. The product is suitable for a nonrotting packaging textile or irrigation textile.

Production process:

The raw material is loaded on a carding machine, close to whose sensing elements are disposed in the sensing unit creating a stuffing slot and a combing element. The combing element is again provided with punch needles. At an offtake speed of 18 m/min, comb speed of 1700 rpm, discharge speed of 1 m/min of the nonwoven textile, a fibrous layer is produced that has a weight of 270 g/m^2 , a thickness of 6 mm, punched into the nonwoven textile.

Claims

1. A fibrous layer designed for nonwoven textiles, especially for insulation and filters, characterized in that the fibers contained in the layer form compressed folds (22) in the form of wavelines extending the entire width of the fibrous layer

(8) and ordered one behind the other in the longitudinal direction of the fibrous layer (8), with the height of the wavelines determining the thickness of the fibrous layer (8).

2. A fibrous layer (8) as described in Claim 1 characterized in that the compressed folds (22) of fiber are connected to each other in the longitudinal direction of the fibrous layer (8) at selected points between the planes defining the thickness of the fibrous layer (8) at selected spacings (t) across the width of the fibrous layer (8).

3. A fibrous layer (8) as described in Claim 2 characterized in that the compressed folds (22) of fibers are bound together by their own fibers.

4. A fibrous layer (8) as described in Claim 2 characterized in that the compressed folds (22) of fibers are connected by reinforcing threads (11).

5. A fibrous layer (8) as described in Claim 1 characterized in that the compressed folds (22) of fibers are attached to a flat bearing structure (12).

6. A fibrous layer (8) as described in Claim 1 characterized in that the compressed folds (22) of fibers contain short stiff fibers with a staple of 3 to 7 mm in an amount up to 25 wt% of the fibrous layer.

7. A method for producing fibrous layer as described in Claims 1 to 6, in which a layer of staple fibers is removed by an oscillating take-off element from the surface of a rotating pinned drum of the machine characterized in that the removed fibers from the portion of the circumference of the pinned drum, where that part of the circumference corresponds to one oscillation of the take-off element, is placed between a length of the cited part of the circumference and the resulting fold of

fibers is pressed up against the preceding similarly formed compressed folds, to which it adheres, and is taken off.

8. A method for producing fibrous layer as described in Claim 7 characterized in that some fibers or folds of fibers of each fold are punched between the fibers of the preceding folds at a selected location between the planes defining the thickness of the fibrous layer and at a predetermined spacing across the width of the fibrous layer.

9. A method for producing fibrous layer as described in Claim 7 characterized in that the individual folds of fibers are slid onto stretched threads in the longitudinal direction of the fibrous layer with the threads being led to the working site above the layer of fibers at the rate of the fibrous layer discharge.

10. A method for producing fibrous layer as described in Claim 7 characterized in that the individual folds of fibers are punched by needles into a flat structure led to the work spot below the fibrous layer.

11. Equipment to implement the method as described in Claims 7 to 10, which contains a rotating pinned drum and a oscillating take-off element disposed toward it characterized in that a board (4) is disposed toward the pinned drum (1) and toward the bottom edge (20) of the take-off element (2) at the lowest position of the bottom edge (20) of the take-off element (2), and a body (3) is disposed toward the same bottom edge (20) of the take-off element (2) in such a way that the board (4) and the body (3) form a slot (21) running the entire width of the pinned drum (1), with the bottom edge (20) of the take-off element (2) being oriented in the working position before slot (21).

12. Equipment as described in Claim 11 characterized in that the position of the body (3) is adjustable relative to the board (4) and is so shaped as to form a minimum width slot (21).

13. Equipment as described in Claim 11 characterized in that body (3) is surrounded by a flexible planchet (31), one end of which is connected to the shaft (17) of the take-off element (2), while its opposite side is placed next to the board (4).

14. Equipment as described in Claim 12 characterized in that the lower edge (23) of body (3), creating a minimum width slot (21), is flexible.

15. Equipment as described in Claim 11 characterized in that the take-off bar (18) of the take-off element (2) is provided, at selected spacings (t), with needles (13) with external cuts (15), with the needles (13) being bent to an arc of radius (R), which is the same as the radius of oscillation of the bottom edge (20) of the take-off bar (18).

16. Equipment as described in Claim 11 characterized in that the bottom conveyer belt (6) is positioned below the board (4) and the top conveyer belt (5) is positioned above it.

17. Equipment as described in Claim 16 characterized in that the bottom conveyer belt (6) is provided with a cam (9) positioned below the entire width of the upper branch of the bottom conveyer belt (6).

18. Equipment as described in Claim 11 characterized in that the upper conveyer belt (5) serves as the body (3).

19. Equipment as described in Claim 11 characterized in that the bottom conveyer belt (6) serves as the board (4).

20. Equipment as described in Claim 11 characterized in that the rotating drum forms the body (3) and extends the entire width of the machine parallel to the board (4).

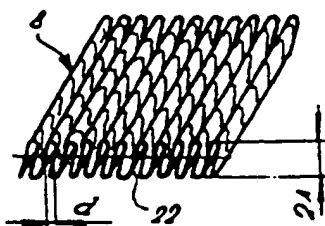


Figure 1

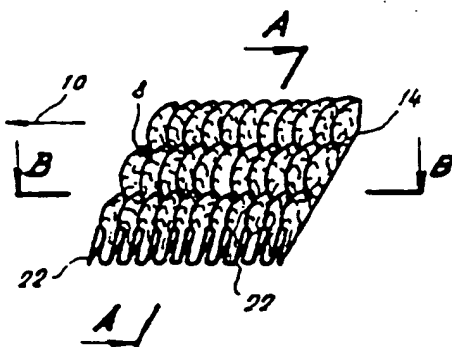


Figure 2

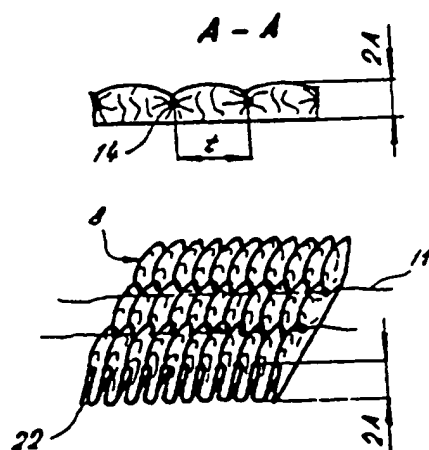


Figure 3

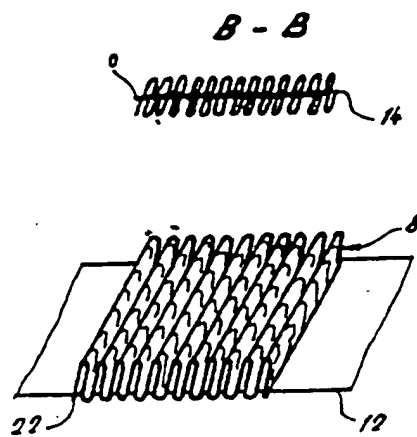


Figure 4

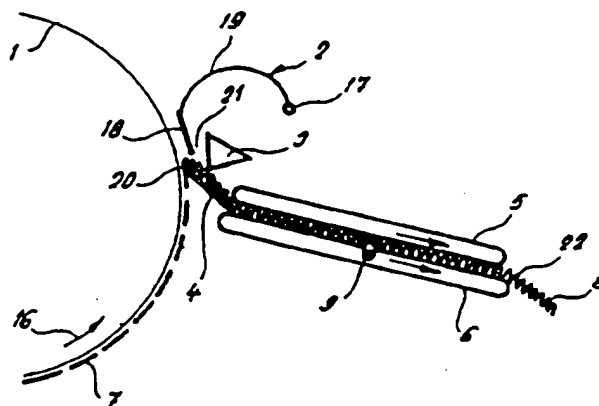


Figure 5

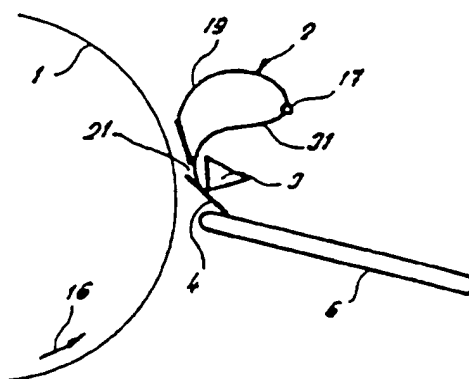


Figure 6

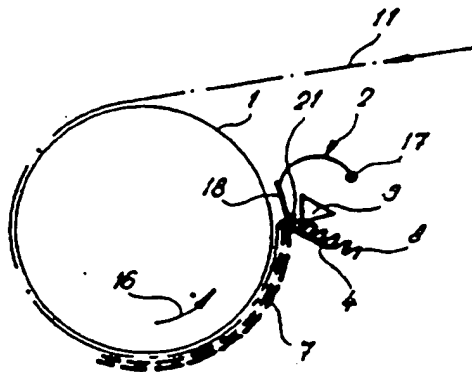


Figure 7

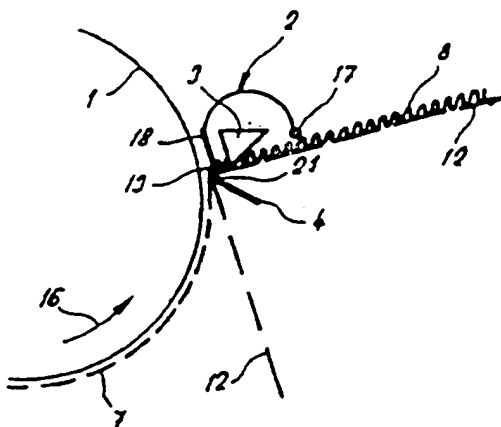


Figure 8

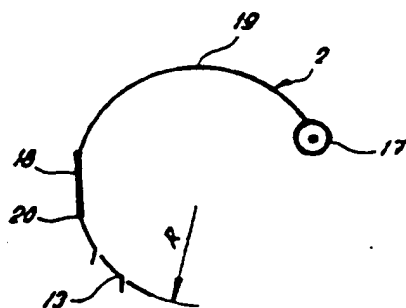


Figure 9

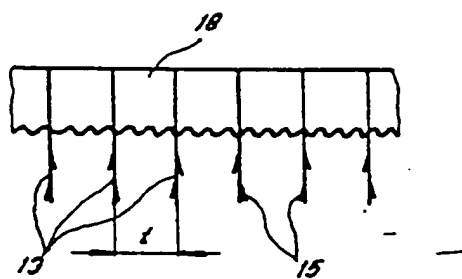


Figure 10

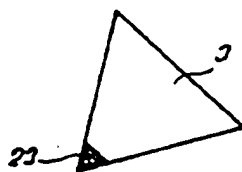


Figure 11

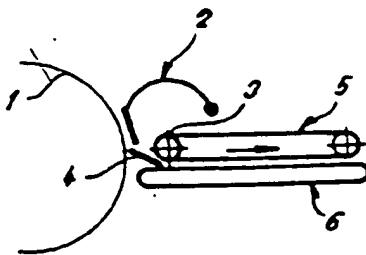


Figure 12

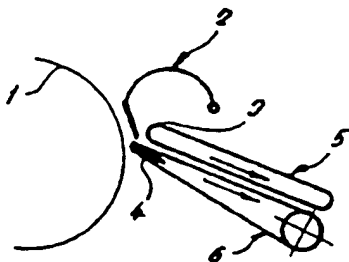


Figure 13